

## Research Paper ■

# Implementation and Use of an Electronic Health Record within the Indian Health Service

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**Abstract Objectives:** There are limited data regarding implementing electronic health records (EHR) in underserved settings. We evaluated the implementation of an EHR within the Indian Health Service (IHS), a federally funded health system for Native Americans.

**Design:** We surveyed 223 primary care clinicians practicing at 26 IHS health centers that implemented an EHR between 2003 and 2005.

**Methods:** The survey instrument assessed clinician attitudes regarding EHR implementation, current utilization of individual EHR functions, and attitudes regarding the use of information technology to improve quality of care in underserved settings. We fit a multivariable logistic regression model to identify correlates of increased utilization of the EHR.

**Results:** The overall response rate was 56%. Of responding clinicians, 66% felt that the EHR implementation process was positive. One-third (35%) believed that the EHR improved overall quality of care, with many (39%) feeling that it decreased the quality of the patient–doctor interaction. One-third of clinicians (34%) reported consistent use of electronic reminders, and self-report that EHRs improve quality was strongly associated with increased utilization of the EHR (odds ratio 3.03, 95% confidence interval 1.05–8.8). The majority (87%) of clinicians felt that information technology could potentially improve quality of care in rural and underserved settings through the use of tools such as online information sources, telemedicine programs, and electronic health records.

**Conclusions:** Clinicians support the use of information technology to improve quality in underserved settings, but many felt that it was not currently fulfilling its potential in the IHS, potentially due to limited use of key functions within the EHR.

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## Introduction

Persistent deficiencies in the quality of US health care have been documented, to affect patients of diverse backgrounds. Racial and ethnic minorities often receive worse care than whites.<sup>1</sup> Native Americans are at particular risk for receiving low quality care compared to other populations.<sup>2,3</sup> This increased risk relates in part to the difficulties inherent to delivering care in remote locations, barriers related to cross-

cultural communication, and the pervasive problem of providing care in the setting of severe resource constraints.<sup>4</sup>

Electronic health records have been promoted as a potential tool for narrowing the quality gap.<sup>5</sup> The benefits of electronic health records include increased use of appropriate preventive services,<sup>6</sup> improved chronic disease management,<sup>7</sup> and reduction in medical errors.<sup>8</sup> However, data describing the implementation of this technology have focused to date mainly on urban or suburban centers and academic medical centers.<sup>9–14</sup> Few U.S. studies have been carried out assessing how effectively electronic health records can be implemented in rural and underserved settings, or how effectively they are used in these settings.<sup>15</sup> Such settings may lack infrastructure needed to support an electronic health record. Equally as important, clinicians already report significant constraints to delivering routine care in these settings,<sup>16</sup> and may view electronic health records as having limited value in addressing the particular needs of their patient population. Yet, the efficient use of new technology may overcome many barriers to high quality care through more effective population management and by facilitating remote access to current medical information via electronic decision support tools or the Internet.<sup>15</sup>

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The Indian Health Service (IHS) provides care to members of American Indian and Alaska Native tribes across the United States through an integrated network of ambulatory health centers and hospitals. This health system provides care in the setting of limited clinician availability,<sup>17</sup> and cares for a culturally diverse patient population in which approximately one-third have incomes below the poverty level and there is a substantial burden of chronic disease.<sup>3,18</sup> Despite these challenges, the IHS has committed to using information systems to support a variety of quality improvement initiatives over recent years,<sup>2</sup> and in 2003 began implementing an electronic health record across many of its health centers as part of a national initiative.<sup>19</sup>

We surveyed primary care clinicians at clinics that implemented the IHS electronic health record between 2003 and 2005 to evaluate 1) attitudes regarding the utility of electronic health records and other forms of information technology in improving care, and 2) predictors of regular use of key functions of the new electronic health record that impact quality of care.

## Methods

### Study Setting

The IHS provides health care to 1.5 million Native Americans, representing approximately 60% of the 2.5 million individuals reporting American Indian or Alaska Native race alone in the 2000 census. The IHS consists of three units: 1) the federally operated IHS direct care system consisting of 36 hospitals and 110 outpatient centers; 2) the tribally operated health centers consisting of 13 hospitals, 259 outpatient centers, and 176 Alaska village clinics; and 3) urban Indian health care services consisting of 34 individual programs. There are currently approximately 1,000 federally employed physicians providing care within the IHS.

Among the 26 health centers that implemented the electronic health record between 2003 and 2005, the majority (69%) were federally operated, with the remainder representing tribally operated health centers (31%). The clinics were more concentrated in the western portion of the country, including the Mountain (58%) and Pacific (19%) census regions. The remaining health centers were located in the West South Central (12%), South Atlantic (8%), and West North Central (4%) regions. The size of each facility varied, with a median of 5.0 (interquartile range 2 to 19) physicians, and a median of 2.0 (interquartile range 1 to 6) mid-level providers per clinic.

### Electronic Health Record Development and Implementation

Prior to implementing the electronic health record, the IHS relied primarily on an internally developed medical record system that stored electronic clinical data such as laboratory and radiology results, but lacked many features of a fully functional electronic health record including clinician order entry, note authoring, and decision support tools (e.g., reminder systems).<sup>2</sup> The IHS has developed a new electronic health record which provides these additional functionalities with a user friendly interface,<sup>19</sup> and is based in part on the system used by the Veterans Health Administration.<sup>20</sup>

All federally operated IHS health centers have been mandated to implement the electronic health record by 2008, and

all tribally operated and urban clinics have been or will be offered implementation. The IHS Office of Information Technology launched a national effort to promote the benefits of the electronic health record and subsequently developed a comprehensive deployment and training program for all clinical sites interested in implementing the new system (please see Appendix 1). Interested sites identified their own local clinical champion to oversee the implementation process. Direct site visits and surveys were used to conduct readiness assessments for each site that included an evaluation for the presence of adequate hardware (servers, personal computers), information technology support staff, and local financial commitment. The sites followed an incremental implementation plan to minimize impacts on productivity and business flow. For example, implementation of clinical reminders was deferred at most sites for one year after initial electronic health record deployment.

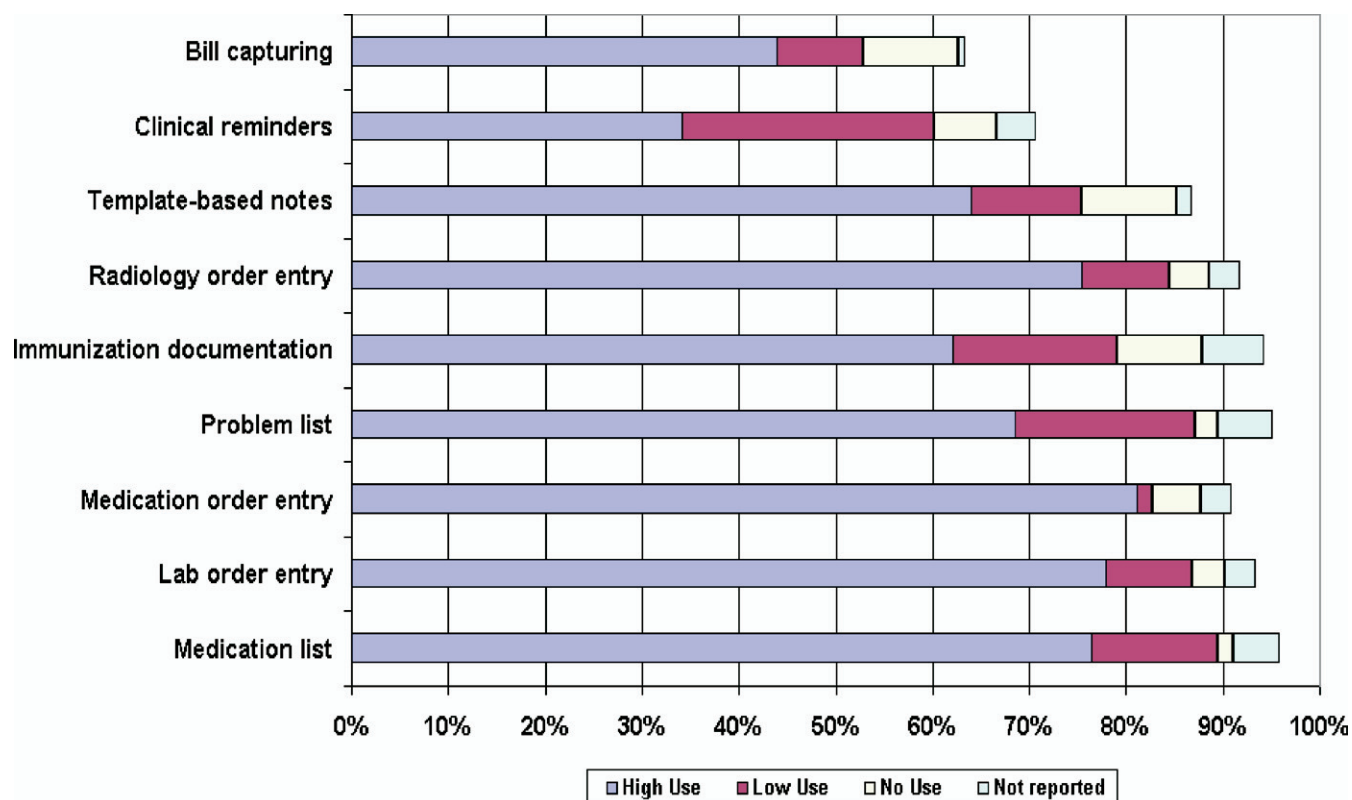
### Electronic Health Record Champion Survey

We surveyed the designated champion for the implementation of the IHS electronic health record at the 26 health centers to gain information regarding the perceived impetus for implementation (local versus national initiative) and overall success of the implementation. The perceived impetus for implementation at the local and national level was measured using a 5-point Likert scale. Perceived success of the implementation was measured using a binary (yes/no) response. Surveys were delivered via e-mail and followed up by two reminder telephone calls to non-respondents.

### Clinician Survey

We surveyed all 223 primary care clinicians, including physicians, nurse practitioners, and physician assistants working in one of the 26 health centers that had implemented the IHS electronic health record between June 2003 and December 2005. The survey was limited to primary care clinicians, because they are the target users for long-term maintenance of electronic medication and problem lists, as well as clinical reminders recommending overdue care. This survey was closely modeled on an instrument used to ascertain the implementation of electronic health records in Massachusetts primary care practices.<sup>21</sup> The original questionnaire collected information on 1) individual and clinical practice characteristics (e.g., clinical volume, length of time in practice); 2) current use and perceived benefit of information technology in medicine; and 3) attitudes regarding the implementation and current use of an electronic health record. We extended the instrument to also assess clinician perceptions regarding the utility of information technology in rural and underserved settings and the ability of electronic health records to assist in the delivery of culturally appropriate care (please see Appendix 2 for full survey instrument, available online at [www.jamia.org](http://www.jamia.org)). The survey was administered using a three stage process that involved 1) an initial hard copy mailing with invitation to complete an online version of survey; 2) a reminder e-mail with the option of completing an attached electronic survey form; and 3) a final hard copy mailing. A total of 125 primary care clinicians responded to the survey (response rate = 56%).

Use of individual key functions within the electronic health record was measured on a three-point scale ("I do not use," "I use some of the time," "I use most or all of the time"). Key functions were identified based on their relative importance



**Figure 1.** Clinician Reported Use of Key Electronic Health Record Functionality. The length of each bar indicates proportion of clinicians reporting availability of a key function, and the colored areas indicate distribution of use among those clinicians reporting the key function is available.

to improving some aspect of quality of care in the context of electronic health records. Clinician attitudes regarding the impact of the electronic health record and information technology on quality of care, patient safety, patient–doctor interactions, rural and underserved health care, and delivery of culturally appropriate care were measured using five-point Likert scales. Barriers to effective implementation of the electronic health record were assessed using a three-point scale (“major barrier,” “minor barrier,” “not a barrier”).

### Statistical Analysis

Individual survey item responses are reported as simple frequencies. We created a usage index to measure overall use of the electronic health record across a broad range of key functions that were selected based on their importance to patient safety and quality of care. This facilitated a concise assessment of electronic health record use and development of predictive models. The usage index was defined as the proportion of individual functions available for which the clinician reported using most or all of the time (Figure 1). The index was calculated by assigning a score of 1 each time a clinician reported high use of a function (“most or all of the time”), summing these over all reported available functions, and dividing by the total number of available functions. We defined high users as those clinicians reporting high use for at least 75% of available functions. We next fit multivariable logistic regression models to identify clinician (gender, clinical experience, patient volume, and beliefs regarding utility of electronic health records) and system (number of training sessions, availability of personal computers, length of time

using the electronic health record) correlates of high use. All analyses were conducted using SAS version 8.02. This study was reviewed and considered exempt by the institutional review boards of the Indian Health Service and Partners Healthcare System.

## Results

### Baseline Characteristics

The response rate for the electronic health record champion survey was 73% ( $n = 19$ ). All responding champions (100%) reported that the local clinic played a substantial role in the decision to implement the IHS electronic health record. In addition, 79% ( $n = 15$ ) reported that the central administration of the national IHS also played such a role. Overall, 87% of responding champions reported the implementation process of the IHS electronic health record to be successful compared to their prior expectations.

A total of 125 primary care clinicians responded to the survey (response rate = 56%). Clinicians had been using the IHS electronic health record for a mean of 542 days (standard deviation 242 days) at the time of the survey. The majority of respondents (59%) were trained in family practice medicine, with internal medicine (25%) and pediatrics (16%) accounting for the remainder of users (Table 1). The mean number of weekly patient encounters reported was  $73 \pm 34$  (standard deviation). A majority (72%) of clinicians practiced in hospital-based clinics, with most (92%) reporting the availability of computers in their personal office, though fewer (61%) had access to computers in the patient

Table 1 ■ Survey Respondent Characteristics

Characteristic	Frequency (%)
Sex	
Male	68 (59)
Clinical background	
Physician	99 (79)
Nurse practitioner	20 (16)
Physician assistant	6 (5)
Family practice	68 (59)
Internal medicine	29 (25)
Pediatrics	18 (16)
Years since completed clinical training	
≤5	40 (32)
6–10	25 (20)
11–20	37 (30)
>20	23 (18)
Clinical practice characteristics	
Hospital-based clinic	90 (72)
Mean weekly patient visits (± SD)	73 ± 34
Personal computers in every exam room	74 (61)
Personal computer in personal office	112 (92)
Use of Information Technology	
Daily Internet use	110 (89)
E-mail communication with colleagues	115 (93)

exam rooms. Most clinicians reported using the Internet daily (89%) and using e-mail to communicate with colleagues (93%). Only 35% of respondents described themselves as an early adopter of new diagnostic tests or treatments.

### Electronic Health Record Implementation and Usage

Training sessions on use of the electronic health record were attended by 94% of clinicians, with 47% attending more than two sessions. Among clinicians, 66% described the process of implementing the electronic health record as somewhat positive or very positive (Table 2). Clinicians are actively using the electronic health record, with 78% reporting use with every patient encounter, and only 5% reporting that they never use it. In addition to using the electronic health record during regular office hours, 73%

of clinicians report using it outside of clinical sessions on a regular basis, with 29% reporting greater than 3 hours per week of such use.

Figure 1 depicts the use of key elements of the electronic health record. The highest levels of consistent use (using most or all of the time) were reported for medication order entry (81%), laboratory order entry (78%), and radiology order entry (75%). Low levels of consistent use were reported for electronic clinical reminders (34%) and electronic bill capturing (44%). Approximately two-thirds of clinicians were classified as high users of all key elements of the electronic health record based on the summary index score greater than 75%. Significant univariate predictors of high usage included increasing years since completion of clinical training and self-report that electronic health records improve quality of care (Table 3). In multivariate analyses, only self-report that electronic health records improve quality (odds ratio 3, 95% confidence interval 1.1–8.8) was associated with high usage of electronic health record functionality.

Only about one-third of clinicians strongly agreed or agreed that the electronic health record improved quality of care (35%) or patient safety (36%, Table 2). Approximately one-third (39%) of clinicians strongly agreed or agreed that the electronic health record significantly decreased the quality of the patient–doctor interaction, with 60% reporting that it decreased the amount of time available to talk with patients. Major barriers to the effective implementation of the electronic health record were divided among computer technical issues and clinical issues (Table 4). Technical limitations of computers (e.g., slow response time) and clinical productivity loss were the most commonly reported barriers in these two domains.

### Information Technology and Rural/Underserved Settings

Over two thirds (68%) of clinicians reported that geography represents a significant barrier to the delivery of high quality care among Native Americans, and the vast majority (87%) felt that information technology could improve quality of care in rural or underserved settings (Table 2). Among

Table 2 ■ Clinician Perceptions of Electronic Health Record Implementation and Utility of Information Technology

Characteristic	Strongly Agree n (%)	Agree n (%)	Neither Agree nor Disagree n (%)	Disagree n (%)	Strongly Disagree n (%)
"My attitude towards the EHR implementation was..."*	36 (29)	45 (37)	8 (7)	27 (22)	7 (6)
"The EHR helps me to improve quality of care"	14 (12)	27 (23)	45 (38)	16 (14)	15 (13)
"The EHR helps me to improve patient safety"	8 (7)	34 (29)	43 (36)	20 (17)	13 (11)
"The EHR decreases the quality of the patient–physician interaction"	33 (27)	15 (12)	32 (26)	30 (24)	13 (11)
"The EHR creates less time to talk with patients in the office"	44 (36)	29 (24)	22 (18)	21 (17)	7 (6)
"Geography represents a significant barrier to providing high quality care for my patients"	31 (26)	49 (42)	20 (17)	14 (12)	4 (3)
"Information technology can improve quality of care in rural and underserved settings"	43 (36)	60 (51)	13 (11)	1 (1)	1 (1)
"The EHR can help enhance delivery of culturally appropriate care"	8 (7)	30 (25)	61 (52)	13 (11)	6 (5)

EHR = Electronic Health Record.

\*The 5 point Likert scale for this survey item was labeled "Very positive," "Somewhat positive," "Neither positive nor negative," "Somewhat negative," "Very negative."



Table 3 ■ Univariate Correlates of Electronic Health Record High Usage\*

Clinician Characteristic	Odds Ratio (95% Confidence Interval)	p-value
Male sex	1.9 (0.91, 3.9)	0.09
Years in practice	1.05 (1.0, 1.10)	0.05
Weekly patient volume	0.99 (0.98, 1.0)	0.15
Increased electronic health record training (>2 sessions)	0.92 (0.45, 1.9)	0.81
Years using the electronic health record	1.7 (0.97, 3.0)	0.06
Personal computers in exam room	1.4 (0.65, 2.8)	0.42
Personal computers in personal office	1.0 (0.28, 3.9)	0.96
Belief that electronic health records improve quality	3.9 (1.6, 9.5)	0.002

\*High usage defined as using at least 75% of available individual functions most or all of the time (compared to some or none of the time).

clinicians reporting a beneficial effect of information technology in rural or underserved settings, access to online information sources (98%), telemedicine programs (81%), e-mail consultation (80%), and electronic health records (75%) were considered by responders to be the most useful technologies.

One-third (32%) of clinicians felt that an electronic health record could enhance the delivery of culturally appropriate care (Table 2). Among these clinicians, provision of culturally appropriate patient education material (89%), and access to information about patient tribal affiliation (51%) and language proficiency (45%) were reported as potential uses of the electronic health record. The majority of these clinicians (68%) reported that additional training on appropriate methods of simultaneously interacting with the patient and the computer would be helpful.

## Discussion

We found that the majority of primary care clinicians caring for Native American patients within the Indian Health Service feel that information technologies including online resources and electronic health records represent an attractive method of improving health care quality. Despite this support, and reports of a successful electronic health record implementation and fairly high usage of at least basic functions, only about one-third felt that the electronic health record actually helped them to improve quality of care or patient safety. This may be due to perceived downsides such as loss of productivity or decreased time to interact with patients, or to the lack of availability and consistent use of

key functions of the electronic health record that are known to improve quality of care such as clinical reminder systems.<sup>6,7</sup>

Process and structural measures relating to electronic health record implementation such as number of training sessions attended and availability of personal computers in all exam rooms were not associated with increased utilization of these key functions. Instead, clinician beliefs regarding the importance of electronic health records were the strongest correlates of increased utilization. This supports prior evidence of the importance of enlisting clinician support in the implementation of electronic health records,<sup>12</sup> and suggests that organizations need to focus at least as much effort on this aspect as they do on the technical aspects of implementation. Alternatively, increased utilization of the electronic health record may have influenced these clinicians to point out the importance of electronic health records as a quality improvement tool.

An additional consideration is that the perceived benefits of electronic health records toward improving health care quality may become more apparent to clinicians with increasing time since implementation. Our findings of positive attitudes towards the implementation process, but limited support of the benefits regarding quality, may reflect the fact that clinicians had only been using the electronic health record for an average of 1.5 years. It may take longer to overcome personal barriers such as proficiency with using important tools including electronic reminders and computerized physician order entry, as well as systemic barriers such as ensuring adequate technical support. Furthermore, the electronic records themselves are likely to improve with time and iterative refinement.

We assessed both the perceived utility of information technology and the implementation of an electronic health record among clinicians caring for an underserved population in a resource-limited environment. The current movement to expand the use of electronic health records throughout all sectors of the US health care system needs to account for the inherent variability in adopting such technologies in disparate settings. Rural and underserved communities may represent the most challenging environments to implement expensive technologic solutions to quality improvement. Even today, most care is delivered in small practices in the U.S. However, information technology may represent a potential solution to decreasing disparities in care because decision support is delivered for all patients, access to up to date health information is improved, long distance clinical consultation or delivery of health care through telemedicine

Table 4 ■ Perceived Barriers to Effective Implementation of the Indian Health Service Electronic Health Record

	Major Barrier* n (%)	Minor Barrier n (%)	Not a Barrier n (%)
Computer-related issues			
Technical limitations of computers (e.g., slow response times)	52 (44)	53 (45)	14 (12)
Availability of technical support	47 (40)	47 (40)	25 (21)
Lack of training	33 (28)	49 (41)	37 (31)
Clinician computer skills	24 (20)	64 (54)	30 (25)
Clinical issues			
Clinical productivity loss	61 (53)	43 (37)	12 (10)
Clinician skepticism	25 (21)	64 (54)	29 (25)
Patient privacy or security concerns	8 (7)	38 (32)	73 (61)

\*6 clinicians did not respond.

can be facilitated, and more effective population management is possible.<sup>15</sup> The clinicians in this survey reported that all of these strategies would be important to improving care in their setting, and many felt that the electronic health record could help them to deliver care in a more culturally competent manner. Importantly, training on interacting with the computer and the patient in a more appropriate manner is a subject which is only recently receiving attention.<sup>22,23</sup> The clinicians in this study all practiced within the context of a unique federal health care system, and their experience may not be representative of clinicians in other rural and underserved settings. However, the IHS is the major provider of health care to Native Americans, and thus the findings have important implications for this population.

There are some data regarding adoption of information technology and electronic health records in underserved communities,<sup>24</sup> rural hospital settings,<sup>25</sup> and developing countries,<sup>26,27</sup> but relatively little information is available on the experience of the clinicians working in these settings. The Indian Health Service provides care for a growing Native American population with a large chronic disease burden in the setting of an overall operating budget estimated to provide only 60% of the funding that would be required to provide access to the same services provided by the Federal Employees Health Benefit Program.<sup>28</sup> The implementation of an advanced electronic health record in this setting highlights the importance of commitment of organizational leadership to quality improvement, and can serve as one model of using information technology to improve care for minorities and other at-risk populations.

Our findings should be considered in view of several limitations. In addition to the unique nature of the Indian Health Service, these clinics represent the early wave of clinics that have implemented the electronic health record, potentially biasing the findings towards a group of "early adopter" clinicians. Nonetheless, only one-third of responding clinicians described themselves as early adopters. We also do not have information regarding the usability of the new electronic health record, and how this might have affected both clinician perceptions and use of key functions with the system. Finally, while we have provided an overview of the implementation process and clinician attitudes, we do not currently have information regarding the impact of the new electronic health record on clinical measures of health care quality, which is vital to understanding the importance of this new technology.

## Conclusion

We have evaluated clinician perceptions regarding the implementation of an advanced electronic health record within a health care system serving a minority population with limited resources. Primary care clinician responses highlighted the importance of information technology for improving quality of care in this setting, but only about one-third currently believe that the EHR is improving quality and safety. In addition to exploring barriers to and facilitators of improving care in rural and underserved settings, future work should focus on assessing longitudinal changes in clinician attitudes regarding implementation of electronic health records, as well as the actual impact of these systems on improving quality and safety.

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## Appendix 1 Implementing the Indian Health Service Electronic Health Record

The implementation process began with a national effort by the IHS Office of Information Technology (OIT) to promote the benefits of the electronic health record through internal publications,<sup>19</sup> as well as direct site visits that provided information on the process of implementation, including software upgrades, training, and other

technical requirements. The OIT attempted to address issues up front that have been previously documented as barriers to effective implementation of electronic health records.<sup>12</sup> Clinical sites were made aware of potential early downsides including costs, temporary decreases in clinician productivity, and technical problems with software and hardware. Sites were also encouraged to include clinicians early on in the decision process and to ensure the availability of adequate technical and application support for users.

Once a clinical site decided to implement the IHS electronic health record, a clinical champion for that site was identified who would be responsible for overseeing the implementation process. The OIT conducted a readiness assessment that included collection of information regarding clinical center size and patient volume, current hardware (servers, operating system, networks, etc.), availability of personal computers for clinicians, financial commitment, and existence of information technology support staff both during clinical hours and after hours. Individual sites next received business process and technical assistance from OIT as well as experts from the Veterans Health Administration to deploy the electronic health record. Lessons learned from the first round of implementations informed the development of a comprehensive deployment and training program that was made available to all subsequent implementation sites. The sites followed an incremental implementation plan to minimize impacts on productivity and business flow. For example, implementation of clinical reminders was deferred at most sites for one year after initial electronic health record deployment.